An analytical assessment of the risks to the sustainability of the Portuguese public debt

Cláudia Braz
Banco de Portugal

Maria Manuel Campos
Banco de Portugal

October 2019

Abstract
In spite of recent favourable developments in sovereign debt markets and the strengthened institutional framework at the European level, in several euro area countries - including Portugal - the high government debt ratios remain a source of concern. This article presents an analytical assessment of the sustainability of the Portuguese public debt, partly based on a framework for debt sustainability analysis (DSA) developed by the Eurosystem in 2015. The analysis shows that risks to sustainability have diminished in the recent past, although remaining elevated. In addition, it suggests that continued improvements in the risk assessment of Portuguese public debt are likely in a context of sound fiscal policies and a benign internal and external environment. (JEL: H60, H63, H68)

Introduction

In spite of recent favourable developments in sovereign debt markets and the strengthened institutional framework at the European level, in several euro area countries - including Portugal - the elevated government debt ratios remain a source of concern. This makes the assessment of government liquidity and solvency crucial for policy makers and the general public. Liquidity is related to the ability of governments to service short-run commitments and to roll-over maturing debt at reasonable cost. In turn, solvency represents the governments' ability to generate future primary budget surpluses whose net present value is, at least, as high as the net present value of the outstanding stock of debt, so that its inter-temporal budget constraint is fulfilled.[1]

Frameworks for debt sustainability analysis (DSA) allow assessing governments' liquidity and solvency conditions, while providing a synthetic

Acknowledgements: The authors gratefully acknowledge the technical support and suggestions by Nuno Alves, Othman Bouabdallah, Cristina Checherita-Westphal, Jorge Cunha, Simone Pesce, Pedro Próspero, Paulo Rodrigues, João Semeano and Ana Sequeira. The analyses, opinions and findings of this paper represent the views of the authors, which are not necessarily those of Banco de Portugal or the Eurosystem.

E-mail: crbraz@bportugal.pt; mmcampos@bportugal.pt

1. Refer to Amador *et al.* (2016) and Bouabdallah *et al.* (2017) for a thorough discussion on the relevant concepts related to debt sustainability.

manner of conveying policy-relevant messages. Most international institutions have been using DSA frameworks to assess the risks to public finances sustainability for several decades. Their relevance was confirmed by the euro area sovereign debt crisis and the mounting of public debt ratios. These methodologies have evolved over time, becoming more thorough and complex, but remain very much conditional on (more or less) conventional assumptions. The future path of debt is subject to many drivers and highly uncertain.

The European Commission introduced in 2014 a DSA tool (European Commission 2014) which has been subject to refinements and improvements thereafter. It is used regularly in several analyses and published reports (see Box 1 for further details) and is an important part of the European Union (EU) multilateral fiscal surveillance mechanism, with explicit references to debt sustainability in several Stability and Growth Pact (SGP) provisions.

In 2015, the Eurosystem developed a comprehensive DSA framework for euro area sovereigns that has been used in the context of fiscal surveillance for the analysis of risks and vulnerabilities (Bouabdallah *et al.* 2017). The Eurosystem framework was reviewed in 2018 and further refinements introduced.[2] This framework comprises three main building blocks: (i) a deterministic DSA; (ii) a stochastic DSA; and (iii) a block of other relevant indicators capturing liquidity and solvency risks. The information embedded in the three blocks can be condensed into an overall four-colour heat map of debt sustainability risks (red for very high risk, orange for high risk, yellow for medium risk and green for contained risk), providing guidance on the overall assessment of risks to debt sustainability.

This article analyses the developments in the assessment of the risks to Portuguese public debt sustainability on the basis of the different blocks defined in the Eurosystem DSA tool. In addition, for a synthetic analysis, three different weighting schemes are proposed, based on expert judgement, to determine an overall risk score. It is concluded that risks to sustainability have diminished in the recent past, as the benchmark deterministic scenario is becoming more favourable and several other indicators have been showing signs of improvement. On the basis of balanced choices for the weighting schemes, Portugal would be classified in the orange category, showing high risks to public debt sustainability. However, the adoption of sound fiscal policies, coupled with a benign internal and external environment would allow the maintenance of the downward risk trajectory.

This article is organised as follows. After an overview of the Eurosystem methodology, three sections describe the main blocks of this framework. Each section presents a description of the indicators, the quantitative criteria for the

2. Based on the technical work of a Eurosystem team coordinated by C. Checherita-Westphal (ECB) (see Checherita-Westphal *et al.* (2018)). This work benefited from further feedback and comments provided by the members of the Working Group on Public Finance (WGPF).

respective evaluation and an illustration with the current results for Portugal. The following section analyses the developments since 2015 in Portugal in each of the three main blocks and computes an overall risk score on the basis of proposed alternative aggregation schemes. Finally, the last section concludes.

Overview of the Eurosystem methodology

Ideally, a DSA tool should be as comprehensive as possible and encompass medium to long-term debt projections based on credible and realistic assumptions (both economically and politically). Sensitivity analyses to adverse shocks should also be considered. Moreover, it should include a broad-based set of indicators and instruments capable of signalling as much as possible a wide range of risks. These should be sufficient to gauge the short-term liquidity risks, as well as those related to long-term solvency.

The DSA framework developed in Bouabdallah *et al.* (2017) and used in the context of the Eurosystem takes these concerns into account. Indeed, the DSA entails three blocks: a deterministic block; a stochastic block; and a block of "other indicators" - see Table 1 for a schematic depiction.

	Deterministic block		Stochastic block	Other indicators
	Benchmark	Shock scenarios		
Blocks	Rule-based central scenario	Narrative shocks around the benchmark: (1) No-fiscal policy change with ageing costs; (2) Historical; (3) Combined stress test; (4) Interest rate (country-specific) shock; (5) Potential output shock	BVAR-based assessment of uncertainty	(1) Liquidity risk; (2) Market uncertainty and political risk; (3) Structure of debt; (4) Scope for contingent liabilities; (5) Financial position and competitiveness; (6) Institutions and governance
Criteria	(1) Debt level in T+10; (2) Debt dynamics (3) Fiscal fatigue (benchmark)		At T+5: (1) Probability of debt standing above 90% of GDP; (2) Probability of debt not stabilizing; (3) Dispersion in simulated debt paths	Assumed thresholds or in-sample distribution
Aggregation: Heatmap				

TABLE 1. Schematic representation of the Eurosystem DSA framework

Source: Adapted from Bouabdallah *et al.* (2017), with further 2018 revisions.

The deterministic block comprises both a benchmark scenario and a set of adverse shock scenarios, all with a 10-year horizon. Regarding the benchmark, its mechanics are based on plausible assumptions for the evolution of macroeconomic and fiscal drivers of the debt ratio. It embeds a fiscal rule that assumes minimum compliance with the EU fiscal governance framework.

The shock scenarios are thought to measure the resilience of the benchmark to (more) adverse assumptions. All simulations are then evaluated in terms of the level reached by the debt ratio at the end of the horizon and its dynamics. The benchmark is also evaluated in terms of the potential for fiscal fatigue, related to the governments' likelihood of sustaining high primary surpluses given historical developments. As to the stochastic block, it provides a probabilistic measure of the uncertainty around the future debt path, considering a five-year horizon. Finally, the "other indicators" aim at signalling other short and medium to long-term risks to debt sustainability otherwise not captured in the previous blocks. The insight provided by each of the three blocks can be merged into a single country-specific sustainability score and mapped into an easy to read and communicate four-colour heatmap in which red stands for "very high risks", orange for "high risks", yellow for "moderate risks" and green for "contained risks" to debt sustainability.

The deterministic analysis

Most DSA frameworks rely to some extent on deterministic long-term projections for the debt ratio. Typically, as it is the case in the Eurosystem methodology, these projections are anchored in the following debt accumulation equation:

$$\Delta b_t = \frac{iir_t - g_t}{1 + g_t} * b_{t-1} - pb_t + dda_t \quad (1)$$

which provides a simple accounting framework to breakdown the changes in the public debt ratio (Δb_t) into: **i)** the "snowball effect" given by the difference between the implicit interest rate on public debt (iir_t) and the growth rate of nominal GDP (g_t) multiplied by the previous year debt ratio (b_{t-1}); **ii)** the primary balance as a percentage of GDP (pb_t); and **iii)** deficit-debt adjustments as a ratio to GDP (dda_t).

The benchmark deterministic scenario

The benchmark scenario is constructed for a 10-year period, with simulations carried out currently up to 2028. It essentially assumes that governments broadly comply with the minimum requirements under the SGP after the ESCB projection horizon. Moreover, this scenario relies on several other assumptions, which are presented below.

The benchmark scenario considers the fiscal projections made in the context of the European System of Central Banks (ESCB) exercises up to

year T+3[3]. From year T+4 onwards, and for countries under the preventive arm of the SGP, as is currently the case of Portugal, the minimum annual adjustment towards reaching the budgetary medium-term objective (MTO) is considered. This is determined by the 'flexibility matrix'[4] but, for prudency, the consolidation effort actually required is adjusted downwards by 0.25 percent of GDP. This figure reflects an estimate of the possible maximum deviation allowed without triggering sanctions under the SGP. In addition, the maximum effort is capped at 0.5 percent of GDP per year.[5] It should be noted that any possible additional fiscal effort required for the fulfilment of the debt rule is not reflected in the benchmark.

The evolution of the **structural primary balance** (spb) beyond T+3 is driven by the convergence to the MTO. In conjunction with an estimate for the cyclical component and an assumption for temporary measures, it allows for the determination of the **primary balance** (pb). The **cyclical component** (cyc) is derived as the product of the output gap by the budgetary semi-elasticity derived on the basis of the ESCB methodology (for an application to the Portuguese case, see Braz *et al.* 2019). **Temporary measures** ($temp$) are assumed to be nil beyond T+3.

For the computation of both the **headline balance** and the **structural balance** a projection of interest payments is required. **Interest payments** (inp) for former programme countries are calculated as the sum of interest paid on market debt (inp^{mk}) and interest paid on loans obtained from official creditors (inp^{of}):

$$inp_t = inp_t^{mk} + inp_t^{of} \tag{2}$$

Interest outlays from official loans are computed on the basis of information on the underlying interest rates and the scheduled redemption profile. Interest payments on market debt are given by the following expression:

$$\begin{aligned} inp_t^{mk} = nmd_{t-1}^{mk} * iir_{t-1}^{mk} + md_{t-1}^{mk} * \frac{1}{2} * (iir_{t-1}^{mk} + amir_t) + \\ \frac{1}{2} * (-pb_t + inp_t^{mk} + inp_t^{of} + dda_t - \Delta D_t^{of}) * amir_t \end{aligned} \tag{3}$$

3. In the case of Portugal, these fiscal projections are confidential and not made public.

4. Introduced by the European Commission Communication on 'Making the best use of the flexibility within the existing rules of the Stability and Growth Pact' in 2015. See `https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0012&from=EN`.

5. For countries subject to an Excessive Deficit Procedure (EDP) the annual structural effort required under the latest EDP recommendation is considered, unless it is above the government plans in the Stability Programme. For countries at or above the MTO, a gradual fiscal stimulus - limited to 1 percent of GDP per year - is assumed such that countries remain at, or return to, the respective MTOs.

where
nmd^{mk} - market debt with a residual maturity of more than one year;
iir^{mk} - implicit interest rate on market debt (defined as the ratio of interest payments on market debt of year t divided by the market debt stock of at the end of $t-1$);
md^{mk} - market debt with a residual maturity of one year or less;
$amir$ - average market interest rate (defined below);
pb - primary balance;
dda - deficit-debt adjustments, which, as a default assumption, are set to zero beyond the forecasting horizon;
ΔD^{of} - change in the stock of official loans.

Solving for inp_t^{mk} and assuming as a proxy for gross financing needs the following expression: $gfn_t = md_{t-1}^{mk} - (spb_t + cyc_t + temp_t) + inp_{t-1}^{mk} + inp_t^{of} + dda_t - \Delta D_t^{of}$, the previous formula can be simplified as:

$$inp_t^{mk} = \frac{nmd_{t-1}^{mk} * iir_{t-1}^{mk} + md_{t-1}^{mk} * \frac{1}{2} * iir_{t-1}^{mk} + \frac{1}{2} * (gfn_t - inp_{t-1}^{mk}) * amir_t}{1 - \frac{1}{2} * amir_t} \tag{4}$$

For market debt that does not mature within the year, the previous year implicit interest rate is assumed to hold, while for the maturing market debt a different assumption is made for each half of the year: in the first semester interest paid stems from the previous year implicit interest rate, as it is considered that all debt matures at the end of June; in the second semester, rolled-over debt is financed at the average market rates. The (proxy for) net financing needs (the headline deficit, deficit-debt adjustments and the repayment of official loans) is financed at market conditions and is considered to be issued, on average, at the middle of the year.

The **average market interest rate** ($amir$) is assumed as representative of the market interest conditions for the debt to be issued in each year. For the structure of this debt, it is used as a proxy the structure of the residual maturity of the stock of debt, split in debt with residual maturity below one year, between one and five years, and above five years. The calculation formula is as follows:

$$amir = \frac{1}{2}(stn + stn^{12m})sd^1 + \frac{1}{2}(stn^{12m} + ltn^{5y})sd^{1-5} + \frac{1}{2}(ltn^{5y} + ltn^{10y})sd^5 \tag{5}$$

where
stn - 3-month government security yield;
stn^{12m} - 12-month government security yield;
ltn^{5y} - 5-year government bond yield;
ltn^{10y} - 10-year government bond yield;

sd^1 - share of market debt with residual maturity below 1 year;
sd^{1-5} - share of market debt with residual maturity between 1 and 5 years;
sd^5 - share of market debt with residual maturity above 5 years.

The interest rate assumptions are country-specific. Across the simulation horizon, spot yields for the 12-month, 5-year and 10-year maturities are extended with forward par yields. The latter are derived from yield curves estimated with recourse to the model established by Svensson (1994)[6]. The 3-month government security yield corresponds to expectations implied in futures contracts for developments in the 3-month Euribor rate. For each country, the market debt maturity structure converges linearly to the current euro area average in 2035 ($sd^1 = 20$ percent; $sd^{1-5} = 40$ percent; $sd^5 = 40$ percent).

Lastly, it is important to note that, once the MTO has been reached or overachieved, any further interest payments savings resulting from debt reduction or lower implicit interest rate are considered to be used for fiscal easing (and not towards further debt reduction) for prudency reasons. Also, in order to avoid a structural break between T+3 and T+4, an adjustment is carried out to smooth the transition from the forecast exercise period to the more extended horizon, on which interest payments projections are reliant on the above-mentioned formula.

Regarding **macro variables**, the ESCB projections are considered within the forecast horizon, with the exception of **potential GDP** for which projections are made for the whole DSA time horizon.[7] From T+4 onwards, **real GDP** growth (y) projections are derived from a simple stylised model that takes into account persistence effects (through an autoregressive process), potential GDP growth (y^p) and the previous year output gap (OG)[8], as well as the impact of additional fiscal consolidation or stimulus (measured by the change in the structural primary balance - ΔSPB) through a fiscal multiplier,

6. In order to derive the implicit average annual interest rate from the market price of a coupon bearing bond, each future interest payment on this bond has to be discounted by the different current average interest rates related to the time at which the future payment occurs. To facilitate the term structure estimation, it is useful to impose a functional form between interest rates and time to maturity. The ECB has chosen a functional form proposed by Nelson and Siegel - and extended by Svensson. The respective parameters are estimated and made public by the ECB on a daily basis; see ECB (2008).

7. The Eurosystem's DSA takes into account estimates for potential output produced by the ESCB Working Group on Forecasting. For specific details on the estimation of potential output for Portugal, refer to Braz *et al.* (2019).

8. In the absence of additional fiscal consolidation or stimulus, the closure of the output gap is ensured in 5 years.

set at 0.55. Specifically,

$$y_t = \begin{cases} 0.5y_{t-1} + 0.5y_t^p - 0.55\Delta SPB_t - 0.2OG_{t-1} \ \textbf{if} \ (y_{t-1} - y_t^p) * OG_{t-1} > 0 \\ y_t^p - 0.55\Delta SPB_t - 0.2OG_{t-1} \ \textbf{if} \ (y_{t-1} - y_t^p) * OG_{t-1} < 0 \end{cases} \tag{6}$$

The two-regime representation ensures a smoother path for real GDP growth by not including the autoregressive term in the cases where the output gap is already closing $[(y_{t-1} - y_t^p) * OG_{t-1} < 0]$.

The **GDP deflator** growth rate is assumed to converge linearly, after the short-term forecasting horizon, to the ECB objective for price stability.

The deterministic shock scenarios

In order to reflect the uncertainty around the projection of future debt path and its sensitiveness to the underlying assumptions, the deterministic block of the Eurosystem's DSA encompasses several alternative adverse scenarios. These result from specific narrative shocks applied as of the first year of the simulations (T+1). Although they are homogeneously applied to each country, the shocks are inherently country-specific. Adverse shocks affecting real GDP growth impact the evolution of primary balances through country-specific fiscal elasticities. Moreover, the fiscal rule embedded in the benchmark scenario does not operate, so that fiscal policy does not react to deteriorations in structural positions. Shocks to interest payments, in turn, are captured through a risk premium channel according to which a 1 pp increase in the deficit-to-GDP or in the debt ratios implies an increase in spreads by, respectively, 25 and 4 basis points. Specific details on each of the shock scenarios are provided below.

Historical. Keeps all the assumptions of the benchmark unchanged, except as regards real GDP growth and the primary balance (net of support to the banking sector). In particular, as of T+1, both variables are assumed to converge within three years to their historical averages recorded over 2001-2013. Convergence to the long-run historical figures typically implies lower economic growth and smaller primary balances compared to the benchmark scenario, thus providing insight on the uncertainty around some of the key driving assumptions of the debt path.

No-fiscal policy-change with ageing costs. Assumes the absence of consolidation as of T+3. In particular, this implies that the structural primary balance remains constant at the level corresponding to the last year of the ESCB projection. Additionally, the fiscal burden associated with population ageing (as estimated in the risk scenario of the 2018 Ageing Report) is taken into account, rendering this scenario particularly adverse for countries projected

to face higher ageing-related challenges (and those for which the structural balance is forecast to fall short of the MTO in T+3).

Combined stress test. In this scenario, shocks are applied to real GDP growth, the GDP deflator and the 10-year sovereign bond spreads. These are calibrated as per the country-specific assumptions underlying the adverse systemic risk scenario from the 2018 bank stress tests performed by the European Banking Authority (EBA). In practice, these shocks are applied from 2019 to 2021 and imply that, at the end of 2020, real GDP stands below the level recorded in 2017, yielding negative growth rates in that period. In addition, the scenario assumes an hysteresis effect through which (half of) the shock to real GDP affects potential growth in the longer-term, thus yielding a further deterioration in the structural fiscal position. This is the most adverse scenario considered in the DSA, rendering the highest debt-to-GDP ratio at the end of the horizon.

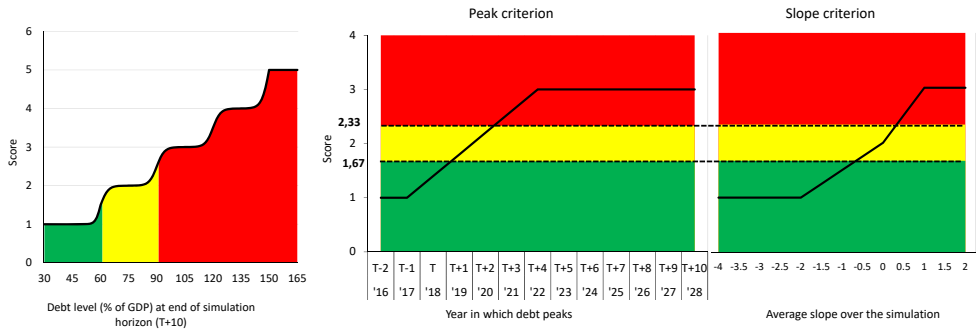
Country-specific interest rate shock. For each country, the interest rate-growth differential converges to its historical average (computed over 1999-2017) by the end of the simulation horizon. The shock is applied to the implicit interest rate on market debt, holding GDP growth and inflation as in the benchmark scenario and assuming no additional consolidation efforts. This implies that the shock affects the debt path gradually over the horizon, as market debt matures and is replaced by new issuance. In order to ensure that this remains an adverse scenario, in the case of countries for which the historical interest-rate growth differential is either negative or stands below the benchmark, it is assumed to converge to 0.5 pp.

Structural shock. Potential GDP growth is negatively affected by a shock calibrated on the basis of an empirical measure of past uncertainty. In particular, the contributions of capital and total factor productivity converge in 10 years to the medians of the respective historical distributions, reduced by one standard-deviation. Regarding the labour factor, it is kept as in the benchmark. Note that this downward shock to potential growth does not allow it to become negative, as the resulting rates are floored at zero. As to the remaining macroeconomic and fiscal variables, they are assumed to evolve in line with the scenario of no-fiscal policy-change with ageing costs.

Quantitative evaluation criteria

Both the benchmark and the alternative shock scenarios are evaluated in terms of the debt level at the end of the 10-year simulation horizon and the dynamics exhibited by the debt ratio over that period. The benchmark is further evaluated against a fiscal fatigue indicator.

The rationale for the **debt level** criterion lies in the notion that a high level of public debt implies stronger sustainability risks. It is typically associated with larger gross financing needs and requires the maintenance of higher primary balances to make it sustainable over the long-term, thereby reducing the margin for counter-cyclical fiscal policy. In the short-term, it may also have unfavourable effects if perceived by market participants as a signal of fiscal distress, potentially triggering liquidity crises. The Eurosystem's DSA evaluates the debt level as a percentage of GDP at T+10 both in the benchmark and in the shock scenarios on the basis of five thresholds: 30%; 60% (as embedded in the EU fiscal surveillance framework); 90%; 120%; and 150%. In order to mitigate cliff effects in the vicinity of these thresholds, the score is derived using a continuous scheme with non-linear smoothing around them. Panel (A) in Figure 1 illustrates this scheme. In terms of the traffic-light colour system, green is allocated to countries for which, at T+10, the debt ratio is at or below 60% of GDP, ratios between 61% and 90% yield a yellow, whereas red corresponds to debt-to-GDP levels above 90%.



(A) Debt level criterion (B) Dynamics criterion

FIGURE 1: Scoring systems for evaluating the debt level and dynamics criteria

Sources: Own illustration, based on the Eurosystem method.
Notes: For convenience, the horizontal axis in the chart referring to the peak criterion presents the relevant years for assessment in the June 2019 DSA exercise (in which T=2018).

Regarding the **debt dynamics** criterion, it aims at capturing the fact that a continuously downward debt path can be perceived by market participants as a sign of improving conditions, even if the level remains high. By the same token, rising debt levels may generate sustainability concerns. In order to reflect these considerations, two dimensions are taken into account when evaluating the debt paths in both the benchmark and the shock scenarios: the year in which debt peaks and the slope of its trajectory.

In particular, the later the debt ratio reaches its peak, the higher the corresponding risk score. Countries in which the debt peaked at least

two years before the start of the simulation period (*ie*, in or before T-1, corresponding to 2017 or earlier in the current exercise), have the lowest risk score of 1. The score increases by 0.4 for each additional year of delay up to a score of 3 if debt peaks after T+3 (or if it fails to reach a maximum within the simulation period). For the slope sub-criterion, the score is a function of a weighted average of the annual changes of the debt ratio over the simulation period. Reflecting the higher uncertainty around the final years of the simulation, the largest weight is given to the change in the first year (T+1, weighting 10) and it decays to a weight of 1 in the last year. The average slope is granted a score from 1 to 3, being more (less) favourable for countries simulated to have sharper declines (increases) over the horizon. Panel (B) in Figure 1 illustrates the scoring schemes applicable to the peak and the slope sub-criteria.

Finally, the overall score for the dynamics criterion is derived as the average between the scores referring to the peak and the slope indicators. The only exception refers to countries where the debt level remains below 30% of GDP throughout the simulation horizon, which get a score of 1 in the dynamics criterion. Overall scores of 1.67 or below are allocated to the green risk category, while yellow corresponds to scores higher than 1.67 but lower than 2.33. A score of 2.33 or above yields a red classification.

The DSA benchmark scenario is also evaluated in terms of a **fiscal fatigue** criterion gauging the governments' ability to sustain primary surpluses. Indeed, the benchmark assumes compliance with SGP fiscal commitments (though only to the minimal extent required to avoid sanctions). This makes it a somewhat benign scenario in the sense that structural primary balances are not allowed to post significant deteriorations. Such assumption may imply the maintenance of large primary surpluses for a long period, which, depending on the past track-record, may not be credible. In order to capture the inherent risks, the fiscal fatigue criterion is based on the comparison between the simulated behaviour of the primary balance over the horizon with the following benchmarks: a country-specific historical threshold corresponding to the highest of the five-year moving averages (MA5) of primary balance recorded from 1999 to 2018 (B); a country-specific historical benchmark that takes into account the fact that current debt levels may be different from those recorded in the past in the same country ($B_{adj,t}$)[9]; and common thresholds of 3.1% and 4% of GDP, derived from the literature.

9. When estimating a fiscal reaction function for a panel of euro area countries, Checherita-Westphal and Zdarek (2017) found a coefficient of 0.04 for the impact of a change in the debt level in the primary balance. In line with this estimate, $B_{adj,t} = B + 0.04 \cdot Diff_{debt,t}$, where $Diff_{debt,t}$ corresponds to the difference between each MA5 of the debt ratio in the simulation period and the debt ratio recorded in the year of the highest MA5 primary balance over 1999-2018.

In particular, for each year of the simulation period, the relevant thresholds are defined on the basis of the relationship between B and $B_{adj,t}$:

- A score of 1 (low risk) is given if the MA5 of the primary balance is below $min(B, B_{adj,t})$;
- If it falls between $min(B, B_{adj,t})$ and $max(B, B_{adj,t})$ **or** if the average primary balance over the simulation is higher than 3.1% of GDP but lower than 4%, the score is set at 2 (medium risk);
- High risks of fiscal fatigue, with a score of 3, correspond to years in which the five-year average exceeds $max(B, B_{adj,t})$ **or** the 10-year simulated average primary balance is, at least, as high as 4% of GDP.

The final fiscal fatigue score corresponds to the highest score recorded over the simulation period.

Results of the deterministic analysis for Portugal

In the benchmark scenario, Portugal's debt ratio is estimated to decline gradually, standing at 89.1% in 2028 (Figure 2). The debt level criterion points, as such, to medium-risks (corresponding to a 2.4 score). A -3.5 p.p. weighted average slope over the simulation horizon, together with a score of 1 for the peak criterion, yields a low risk score in the overall dynamics criterion. Regarding the structural balance, the MTO deducted by the maximum deviation allowed to avoid sanctions under the SGP (0.25% of GDP) would be reached in 2022 and maintained thereafter. The cyclical component would converge rapidly to zero, temporary measures are assumed to be nil after 2022 and interest payments as a ratio to GDP decline up to 2022 and increase only slightly in the last years of the simulation horizon. As a result, the primary balance stands in the [2.7; 3.5]% of GDP range, averaging 2.9% of GDP between 2019 and 2028. This implies high risks related to fiscal fatigue.[10] The average growth of nominal GDP underlying the simulation is around 3%.

Figure 3 shows that the most severe scenario for Portugal is the one referring to the combined stress test. Both in this and in the historical scenario, the debt-to-GDP ratio would fail to stabilize within the simulation horizon (yielding a score of 3 in the dynamics criterion, as per Figure 1) and would reach a high level in T+10 (respectively yielding scores of 5 and 4.1, in line with panel (A) of the same figure). The remaining scenarios would also result in a higher debt level at the end of the horizon, but would not jeopardize the downward slope exhibited since 2014 and prolonged in the benchmark.

10. It should be noted that for the purpose of determining the fiscal fatigue score, the highest MA5 of the primary balance (B) in the 1999-2018 period in Portugal is 0.8% of GDP and the benchmark adjusted for debt levels ($B_{adj,t}$) varies in the [-0.5; 0.1]% of GDP interval.

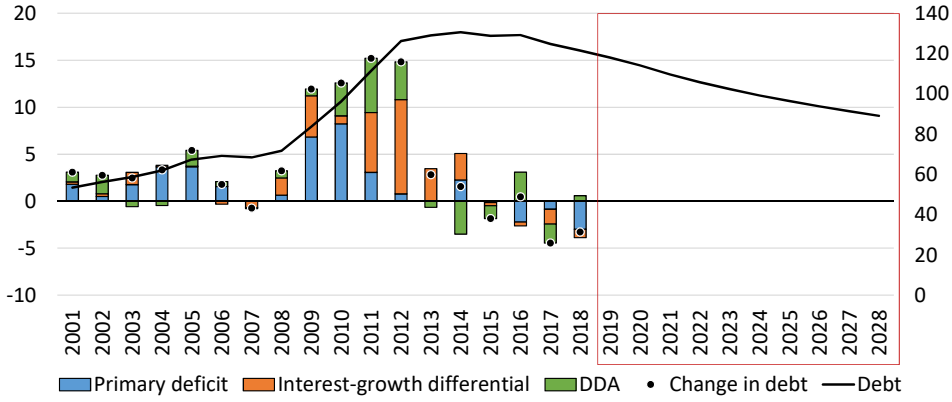


FIGURE 2: Benchmark debt path and its breakdown in Portugal | In percent of GDP

Sources: Statistics Portugal, Banco de Portugal and authors' calculations.

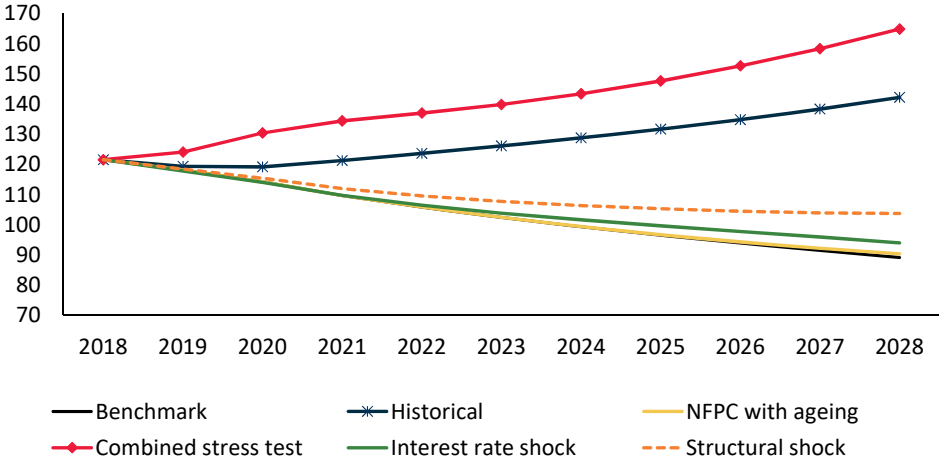


FIGURE 3: Portuguese public debt path in alternative scenarios | In percent of GDP

Sources: Statistics Portugal, Banco de Portugal and authors' calculations.

The stochastic analysis

The deterministic component of the DSA is complemented by a stochastic analysis (SDSA). The latter relies on a set of probabilistic scenarios for the future evolution of public debt, developed on the basis of its empirical relationship with its drivers. In particular, given past responses, macroeconomic drivers are projected according to stochastically simulated

shocks and plugged-in the debt change equation (1) following the same mechanics as in the benchmark scenario, generating alternative debt paths.

In the Eurosystem's DSA, the shocks are simulated from the residuals of a quarterly two-lag VAR model estimated using a Bayesian approach (BVAR) (see Bouabdallah and Cozmanca 2019). The model encompasses four endogenous variables (real GDP growth, GDP deflator growth, short-term government security yields and the real effective exchange rate) and two exogenous variables (a commodity price index and US LIBOR), assuming block-exogeneity. Currently, the estimation sample spans the 1996Q2-2018Q4 period. An independent Normal-Wishard prior is assumed. The priors for the auto regressive parameters are set at 0.5, whereas the prior means of the exogenous coefficients are set at 0, as implied by block-exogeneity.

The independent Normal-Wishard prior implies that the residual covariance is treated as unknown and that the variance of the distribution of coefficients has a flexible structure. In this set-up, parameters cannot be analytically estimated and, thus, the posterior distributions are obtained numerically. In particular, the Eurosystem's SDSA relies on the iterative Gibbs sampling method with 10.000 iterations to obtain random draws from the unconditional posterior distribution of the parameters of interest.

The covariance matrices obtained from Gibbs' method are used to simulate a high number of possible paths for the aforementioned macro variables. Finally, alternative debt paths are generated over a five-year period through the same mechanics as in the benchmark, including the working of the fiscal rule, and considering the simulated cyclical developments.

The large number of debt paths that are simulated using this procedure allow for the derivation of a stable distribution that can be characterised on the basis of several moment statistics or probabilistic analyses. In the Eurosystem's DSA, the simulated distribution is evaluated using three criteria, all focusing at the end of the five-year horizon:

- The uncertainty around the simulations, measured as the difference between the 5^{th} and the 95^{th} percentiles of the distribution of the debt ratio at T+5. For each country, this dispersion is benchmarked against that referring to the euro area sample and, if it stands above the respective 66^{th} percentile, countries are granted a risk score of 3 (meaning that higher uncertainty is associated with higher sustainability risks). If dispersion is between percentiles 66 and 33, countries are assigned to the medium risk category (score of 2), whereas for countries ranked below the 33^{th}, the risk score is 1, signalling low risks.
- The probability of debt standing above 90% of GDP in T+5.
- The probability of debt not stabilizing by T+5.

For the two last criteria, probabilities above 66% receive a score of 3 and are allocated to the red risk category. If the probabilities stand between 33 and 66%, countries are placed in the yellow category and receive a score of 2.

Finally, if they are lower than 33%, signalling low risks for debt sustainability, countries are granted a score of 1 and placed in the green category. The overall score for the SDSA is obtained as the simple average between the scores of the three indicators.

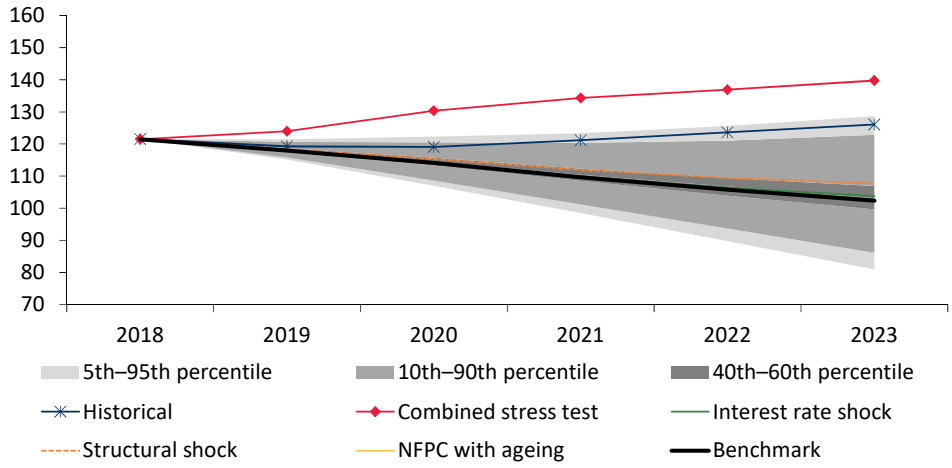


FIGURE 4: Stochastic DSA results for Portugal | In percent of GDP

Sources: Statistics Portugal, Banco de Portugal and authors' calculations.

Figure 4 depicts a fan chart illustrating confidence bands that represent different degrees of uncertainty in the debt paths simulated for Portugal in the latest SDSA iteration. They show that the benchmark scenario largely coincides with the median of the respective distribution. The figure also highlights that the paths corresponding to the most severe adverse scenarios (historical and combined stress test) should be interpreted as highly unlikely, given past developments.

Based on the results summarized in Figure 4, Portugal is placed in the intermediate risk category as regards the dispersion indicator. Unsurprisingly, given the current debt-to-GDP level, the probability of debt standing above 90% of GDP in T+5 (2023) is assessed to be high (red category). Nonetheless, the likelihood of it remaining on a declining trend is also high, yielding a low probability of debt not stabilizing within the five-year horizon (green risk category). Overall, the SDSA score for Portugal is 2, signalling medium risks to debt sustainability.

Other indicators

In addition to the deterministic and stochastic DSA blocks, the Eurosystem's DSA also relies on six groups of other indicators that aim at signalling short-

and medium to long-term sustainability risks, so as to capture potential liquidity and solvency vulnerabilities. In particular, there are two blocks focusing on short-term risks (liquidity risk, and market uncertainty and political risk) and four other blocks providing a longer-term perspective (structure of public debt, scope for contingent liabilities, net financial position of the economy, and institutional and governance factors).

The **liquidity risks** are assessed on the basis of the short-term financing needs [11]. The latter reflect the gross needs related to financing the budget deficit and the debt maturing within one year[12], net of liquid financial assets (currency and deposits). In turn, indicators for **market uncertainty and political risk** aim at gauging the current ease of refinancing. This assessment is based on the markets' perception of sovereign risk (as measured by the 10-year government bond spread vis-à-vis the German Bund and the current sovereign rating) and the political risk indicator produced by a private entity, the PRS Group. Larger financing needs and political risks and poorer market risk perception naturally imply higher short-term sustainability (liquidity) risks.

Potential sources of concern in terms of medium- to long-term sustainability are captured by the four additional blocks of indicators. Indicators for the current **structure of debt** take into account its maturity and its composition in terms of currency and type of interest rate. Higher shares of short-term debt, debt denominated in foreign currencies and debt with a variable interest rate are, in principle, associated with higher vulnerability to adverse shocks which translates into higher sustainability risks.

Higher sustainability risks are also *a priori* associated with a wider **scope for contingent liabilities**. The latter refer to the potential fiscal costs that may arise should certain events materialize. These include the costs related with demographic changes, captured by an "ageing indicator" hinging on the Commission's long-term sustainability indicator S2 and the latest Ageing Report[13]. Moreover, other contingent liabilities are accounted for using a

11. Financing needs estimated for the current year in the June exercise or the following year in the December exercise.

12. The debt maturing in the year encompasses long-term securities maturing within the following 12 months, the stock of short-term debt outstanding at the end of the previous year (both taken from the ECB Centralized Securities Database) and the scheduled repayment of official loans.

13. In particular, the ageing indicator is obtained as the average (2/3; 1/3) between a score compatible with the Commission's long-term sustainability indicator (countries are assigned 1, 2 or 3 depending on the long-term sustainability risks as signalled by the S2 indicator) and the score applicable to the debt level obtained by adding the estimated long-term costs of ageing to the debt level at the end of the DSA period in the benchmark scenario. The estimated costs of ageing correspond to the cumulative impact of age-related spending in the debt level over the 2028-2060 period, as per the AWG risk scenario in the 2018 Ageing Report. In the latest Commission's Fiscal Sustainability Report, the score compatible with the S2 indicator for Portugal stands at 1 (as the S2 indicator signals low risks). In turn, adding the estimated

synthetic indicator that is based on the existing stock of guarantees granted by the general government, the amounts under public-private partnerships (PPP) and non-performing loans granted by government entities. Additional contingent liabilities related to the financial sector are also captured by a financial risks indicator derived from the overall assessment of risk and vulnerabilities in the regular ECB Macro-Prudential Report, which is not publicly available.

The risks to public debt sustainability stemming from the **net financial position of the economy** are assessed through indicators deemed to have high predictive power in signalling sovereign distress: the net international investment position; the private sector stock of debt; and a set of external competitiveness indicators from the EU's Macroeconomic Imbalance Procedure (MIP) scoreboard. The latter refer, in particular, to the changes in unit labour costs and the real effective exchange rate (over the last three years), the (three year average) current account balance and the change in the export market shares (over the last five years).

Finally, risks stemming from each country's **institutional and governance** framework are factored in through a set of indicators providing some insight on the quality of institutions. In particular, this category includes the World Bank's worldwide governance indicators and the Transparency International's corruption perception index. These indicators are intended to proxy the governments' proneness to payback its debt, with higher institutional quality being associated with lower sustainability risks.

Each individual indicator is evaluated using thresholds derived from the empirical literature or based on the reference figures used by the European Commission (when assessing fiscal sustainability risks or in the context of the MIP) and the IMF. When such benchmarks are not available, the thresholds are determined on the basis of the percentile distribution in a sample of advanced economies as defined by the IMF. The only exception is the sub-indicador referring to the share of debt with variable interest rate, for which the relevant sample corresponds to euro area countries across 2001-2018.

Depending on the relevant figures for a specific country and the respective thresholds, each individual indicator is given a score of 1 (indicating low risk), 2 (for medium risk) or 3 (high risk). For each block of indicators - liquidity, market uncertainty and political risk, structure of debt, scope for contingent liabilities, net financial position of the economy, and institutions and governance - an overall score is derived on the basis of the individual scores and a weighting scheme. Finally, the score for each block is classified according to the heatmap colours using the appropriate thresholds: green for

---

cumulative costs of ageing to the debt level at the end of 2028 in the DSA benchmark scenario puts the debt-to-GDP ratio close to 120%, which, according to the criterion described in panel (A) of Figure 1, yields a score of 3.4.

scores below 1.67; yellow for scores ranging between 1.67 and 2.33; and red for scores above 2.33.

The results currently obtained for Portugal show that, out of the full set of indicators, the most relevant risks to Portuguese public debt sustainability stem from the weak net financial position of the economy, the high share of short-term debt and the sizeable stock of contingent liabilities (see Table 3 for the aggregate scores of each category of indicators).

Sustainability assessment for Portugal: recent developments

In Portugal, several risk indicators included in the three DSA blocks have been improving since 2015 (Table 2). On the basis of the colour-scheme, the favourable evolution is noticeable in the debt level and dynamics criteria in both the benchmark and the "no-fiscal-policy-change with ageing" deterministic scenarios, in the stochastic DSA and in some categories of the other indicators.

Regarding the improvement in the deterministic and stochastic blocks, it is worth highlighting that the current perspective for debt ratio developments is much more favourable than the one existing in 2015. Different factors concur to this outcome: revisions of the debt ratio in the base year; lower deficits, which one can typically expect given the prudency principle applied in the elaboration of ESCB fiscal projections and also the stronger than anticipated drop in interest rates; and higher than expected nominal GDP growth. While this more benign developments translate relatively fast to the risk assessment based in the level and dynamics criteria of the deterministic scenarios, they will take much longer to be reflected in the fiscal fatigue criterion.

On the other indicators block, the improvement in both the 10-year Portuguese government bond spreads and the sovereign ratings contributed to the positive evolution of the risk assessment in the liquidity and uncertainty and political risk categories. Regarding the structure of debt, the relatively high share of short term debt continues to weigh on this risk indicator, but the reduction in the share of debt with variable interest rate and in foreign currency had a small favourable impact. The financial sector risks, on the contingent liabilities category, have declined somewhat, while the overall score of the indicators on the financial position and competitiveness and on institutions and governance remained broadly unchanged.

The risks to debt sustainability as highlighted in the three DSA blocks can be summarised in a single sustainability score providing an encompassing assessment that is easy to understand and communicate. The aggregation of the scores of each block into a single indicator is conditional on the choice of a weighting scheme. Such choice may take into account empirical

	2015	2016	2017	2018	2019
Deterministic DSA block					
Benchmark					
Level					
Dynamics					
Fiscal fatigue					
Shock scenarios					
Historical scenario					
Level					
Dynamics					
No-fiscal policy change with ageing					
Level					
Dynamics					
Stress test scenario					
Level					
Dynamics					
Country-specific interest rate shock					
Level					
Dynamics					
Structural shock					
Level					
Dynamics					
Stochastic DSA					
Other indicators					
Liquidity risk					
Uncertainty and political risk	-	-	-	-	
Structure of debt					
Scope for contingent liabilities					
Financial position and competitiveness					
Institutions and governance					

TABLE 2. Evolution of the DSA main indicators in Portugal

Source: Authors' calculations.
Note: The assessment in each year is consistent with the information available in the June projection exercises. Results for 2019 and the previous years are not fully comparable due to a methodological review. In particular, most of the indicators currently underlying the liquidity risk and uncertainty and political risk categories were before grouped in one single category.

considerations, the perceived signalling power of each indicator or simple expert judgement.

Table 3 presents three options to weight the different indicators, all based on expert judgement. The **first option** is more balanced, in the sense that it gives more weight to the benchmark deterministic scenario (25%), equal weigh to each of the deterministic shock scenarios and the stochastic DSA (7.5%) and the remaining weight (30%) is distributed evenly by each of the six other indicators' categories. The **second option** for the weighting scheme is meant to capture more forcefully the risks stemming from the adverse scenarios: it increases the weight of each deterministic shock scenarios and the stochastic DSA to 10%, at the expense of a reduction in the weight of

the benchmark scenario to 10%. Finally, the **third option** favours the other indicators in the overall risk assessment, increasing their joint weight to 45%, while counterbalancing it by a cut to 10% in the weight of the benchmark scenario.

	Block/indicator	Score	Weighting options[(a)] 1	2	3
1	**Deterministic DSA block**		**62.5%**	**60.0%**	**47.5%**
1.1	**Benchmark**		**25.0%**	**10.0%**	**10.0%**
	Level	2.4	10.0%	4.0%	4.0%
	Dynamics	1.0	10.0%	4.0%	4.0%
	Fiscal fatigue	3.0	5.0%	2.0%	2.0%
1.2	**Shock scenarios**		**37.5%**	**50%**	**37.5%**
	Historical scenario		**7.5%**	**10%**	**7.5%**
	Level	4.0	3.8%	5.0%	3.8%
	Dynamics	3.0	3.8%	5.0%	3.8%
	No-fiscal policy change with ageing		**7.5%**	**10.0%**	**7.5%**
	Level	2.5	3.8%	5.0%	3.8%
	Dynamics	1.0	3.8%	5.0%	3.8%
	Stress test scenario		**7.5%**	**10.0%**	**7.5%**
	Level	5.0	3.8%	5.0%	3.8%
	Dynamics	3.0	3.8%	5.0%	3.8%
	Country-specific interest rate shock		**7.5%**	**10.0%**	**7.5%**
	Level	2.9	3.8%	5.0%	3.8%
	Dynamics	1.0	3.8%	5.0%	3.8%
	Structural shock		**7.5%**	**10.0%**	**7.5%**
	Level	3.0	3.8%	5.0%	3.8%
	Dynamics	1.0	3.8%	5.0%	3.8%
2	**Stochastic DSA**	**2.0**	**7.5%**	**10%**	**7.5%**
3	**Other indicators**		**30.0%**	**30.0%**	**45.0%**
	Liquidity risk	2.0	5.0%	5.0%	7.5%
	Uncertainty and political risk	1.6	5.0%	5.0%	7.5%
	Structure of debt	1.8	5.0%	5.0%	7.5%
	Scope for contingent liabilities	1.7	5.0%	5.0%	7.5%
	Financial position and competitiveness	2.6	5.0%	5.0%	7.5%
	Institutions and governance	1.4	5.0%	5.0%	7.5%
Overall results for Portugal: sustainability risk score and category			**2.18**	**2.27**	**2.17**

TABLE 3. Overall debt sustainability assessment in Portugal

Source: Own representation.
Notes: (a) The three weighting schemes and the resulting overall scores were defined by the authors for illustrative purposes.

The overall risk score for each of the weighting options is also shown in Table 3. Having in mind the classification in the four-colour scheme (red - very high sustainability risks for scores above 2.5; orange - high risks for scores between 2.5 and 2.0; yellow - moderate risks if the score stands

between 2.0 and 1.5; and green - contained risks for scores lower than 1.5), Portugal currently emerges as a high risk country (orange category) in the three alternative schemes. Although the overall risk classification depends ultimately on the selected weighting scheme, the high number of indicators considered in the analysis ensures a robust score in case a balanced approach is adopted. Also, moving forward, it appears likely that in the absence of external shocks and under the maintenance of the recent trajectories - anchored in sound fiscal policies, a low interest rate environment and resilient growth - Portugal may transit to the moderate risk category in a relatively short period of time.

Concluding remarks

DSA frameworks are very useful tools for harmonised assessments of sovereign debt vulnerabilities in different countries and across time. Similarly to other methodologies, in the Eurosystem DSA tool the trade-off between comprehensiveness and simplicity becomes apparent when methodological aspects are analysed in some detail. The tool is extremely rich and thorough, covering different instruments and indicators. This comes at the cost of a certain degree of complexity, which is mitigated by the presentation of results in a heatmap colour-scheme and the possibility of aggregation in a single score.

Although the framework allows for the possibility of an easy-to-grasp quantitative assessment, its importance should not be overstated as the determination of a single score is somehow dependent on the weighting of the different indicators. As such, results should be interpreted with caution. In particular, small changes in the overall sustainability risk score may not imply an actual revision in the public debt vulnerability assessment. Larger positive and persistent score changes should, however, act as a warning system for national policies. In addition, the tool does provide valuable insights on the evolution of the several determinants of debt sustainability and allows for comparative analysis when applied cross-country.

The results obtained for Portugal point to the existence of high risks to the sustainability of public debt. These stem not only from the currently high level of government indebtedness and the resulting vulnerability to adverse shocks (as illustrated in the deterministic shock scenarios), but also from structural imbalances (as captured by the financial position and competitiveness indicators). However, when compared to results obtained in previous years, the most recent data points to an improvement in several dimensions of sustainability as captured by the Eurosystem's DSA tool. Also, further improvements in the sustainability assessment are likely to occur, provided that the conduct of fiscal policy remains compatible with the maintenance of high primary surpluses and fiscal buffers are built-up,

particularly taking advantage of the current low interest rate environment. This is crucial to increase the resilience of the Portuguese public debt downward path to adverse shocks.

Box 1. The European Commission's DSA framework

The assessment of fiscal sustainability is a major component of EU's surveillance framework. The European Commission regularly issues reports focusing on the matter, including the Ageing Report, the Fiscal Sustainability Report (both published every three years) and the annual Debt Sustainability Monitor. The Commission's framework provides an overall classification of risks to public finances that largely relies on its sustainability indicators: S0, an early-warning indicator focusing on short-term risks; S1, measuring the fiscal effort required for the debt-to-GDP ratio to reach 60% in the medium-term; and the long-term sustainability indicator S2, which represents the fiscal effort required to stabilise the debt-to GDP ratio over an infinite horizon, taking into account ageing costs. Since 2015, the Commission includes a DSA as part of its overall sustainability assessment, by combining it with S1 when gauging medium-term challenges. This ensures that the impact of different macroeconomic and fiscal assumptions on debt dynamics is dully accounted for. As of 2018, this DSA framework is also used to assess long-term sustainability in conjunction with S2, in order to overcome the limitations of this indicator.[a]

Like the Eurosystem's methodology, the Commission's DSA relies on deterministic debt projections for a 10-year horizon and a stochastic analysis focusing on a five-year period. The deterministic part consists of a baseline scenario assuming no-fiscal policy change (with the structural primary balance remaining constant at the level corresponding to the last year in the Commission's forecast), taking into account ageing-related expenditures, and a historical scenario (according to which the structural primary balance converges to its historical average in four years).[b] The risk assessment focuses on three indicators: the debt-to-GDP level at the end of the 10-year simulation period; the year at which the debt ratio peaks; and the comparison between the average structural primary balance over the simulation horizon and a benchmark provided by the distribution of the same variable in a sample of EU-28 countries (currently over 1980-2018). Thus, this assessment partly disregards the signals in terms of debt dynamics captured by the slopes of the simulated paths. Moreover, gauging the plausibility of primary balances over the simulations could benefit from a stronger country-specific component - as it is the case with the fiscal fatigue indicator in the Eurosystem's DSA framework. The resilience of the deterministic paths is assessed by

applying standardized shocks to the growth rate of GDP, the interest rate and the primary balance, and looking at the resulting debt-to-GDP ratio at the end of the horizon and at the peak year.

Regarding the stochastic analysis, it is based on the simulation of a large number of shocks (2000) derived on the basis of the country-specific historical volatilities and affecting the primary balance, real GDP growth, interest rates and the exchange rate. The resulting simulations are evaluated in terms of the probability of debt standing above the initial level after a five-year period and the dispersion of the distribution of simulated debt paths.

Note that, although not relevant for the determination of the risk category, the Commission's framework includes other alternative scenarios. The respective results may be used complementarily as additional risk or mitigating factors for the purpose of an overall assessment. Such assessment may also take into account additional sensitivity tests and other indicators such as short- and long-term projections for financial needs, market perception, the existing debt profile in terms of maturity, type of currency and holders, as well as governments' assets and liabilities. Most of these considerations are an integral part of the Eurosystem's DSA, which further incorporates risks stemming from institutional factors.

The Commission's overall assessment of fiscal sustainability risks is not summarised in a single score. It rather relies on a three-colour scheme (red, yellow and green, respectively for high, medium or low risks) that may apply differently across time horizons (short, medium or long-term). While the short-term assessment is based solely on the S0 indicator, the results of the DSA contribute to the evaluation of the medium and long-term risk categories, as mentioned before.

In particular, for the overall classification of medium-term fiscal risks, the DSA and the S1 indicator have equal contributions. However, for the sake of prudence, if they point to different categories, the one implying higher risks prevails. As regards the long-term, the S2 indicator prevails over the DSA if the latter points to a lower risk category. On the contrary, if the DSA points to higher risks, the overall classification corresponds to the category immediately above the one implied by S2 (eg, if the DSA points to high or medium risks and S2 signals low risks, risks to debt sustainability would be classified as medium in the long-term).

---

a. In particular, the S2 indicator does not capture vulnerabilities stemming from the fact that debt ratios may stabilize at a very high level.

b. For additional details on the assumptions underlying the various scenarios in the Commission's DSA, refer to Box 1.1 in the 2018 Fiscal Sustainability Report.

References

Amador, J., C. Braz, M.M. Campos, S. Sazedj, and L. Wemans (2016). "Public debt sustainability: Methodologies and debates in European institutions." Banco de Portugal Occasional Paper 1.

Bouabdallah, O., C. Checherita-Westphal, T. Warmedinger, F. Drudi, R. Setzer, R. De Stefani, and A. Westphal (2017). "Debt sustainability analysis for euro area sovereigns: a methodological framework." Occasional Paper Series 185, European Central Bank.

Bouabdallah, O. and B. Cozmanca (2019). "Stochastic debt sustainability analysis for euro area countries: a novel approach." Presentation delivered in the Central Bank of Malta Public Finance Workshop.

Braz, C., M. Campos, and S. Sazedj (2019). "The new ESCB methodology for the calculation of cyclically adjusted budget balances: an application to the Portuguese case." *Banco de Portugal Economic Studies*, V(2), 19–42.

Checherita-Westphal, C., O. Bouabdallah, J. Domingues-Semeano, S. Van Parys, J. Zimmer, D. Papaoikonomou, M. Alloza, P. Burriel, P. Rizza, M. Polemidiotis, O. Delobbe, M. Campos, and J. Kivisto (2018). "Technical revisions to the ESCB debt sustainability analysis (DSA) method." Mimeo.

Checherita-Westphal, C. and V. Zdarek (2017). "Fiscal reaction function and fiscal fatigue: evidence for the euro area." Working Paper 2036, European Central Bank.

ECB (2008). "The new euro area yield curves." *ECB Monthly Bulletin*, February.

European Commission (2014). "Assessing public debt sustainability in EU member states: a guide." *Occasional Papers*, 200, September.

Svensson, L. (1994). "Estimating and interpreting forward interest rates: Sweden 1992-1994." *NBER Working Paper*, (4871).